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The Early Stages of *Doa dora* Neumoegen and Dyar (Lepidoptera: Noctuoidea: Doidae) in Baja California, Mexico

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Abstract. The early stages of *Doa dora* Neumoegen and Dyar from Baja California, Mexico, are described and illustrated. Adults were reared on *Euphorbia misera* Bentham (Euphorbiaceae) from eggs deposited by females collected on Isla de Cedros. The unique combination of larval characters possessed by the doids, i.e., small head, hump-backed thorax, biordinal crochets in a homoideous mesoseries, and integumental spicules, contradict traditional assignments to families of similar adult morphology (i.e., Lymantriidae, Hypsidae, Pericopidae, Artiidae). It is likely that specimens from the northern part of the range of *D. dora* (i.e., Baja California and Sonora, Mexico) represent an undescribed species. Although adults have not been collected in the United States, larvae have been taken in San Diego, California.

Introduction

The genus *Doa* Neumoegen and Dyar (1894) has traditionally defied attempts at familial assignment. Its long history of taxonomic uncertainty includes placement in the Lymantriidae (Dyar 1903; Barnes and McDunnough 1917; Holland 1903; Bryk 1934), Hypsidae (Walton 1912), Pericopidae (Schaus 1927; McDunnough 1938; Peterson 1948), and Arctiidae (Franclemont 1983). Most recently, *Doa* and its sister genus, *Leuculodes* Dyar, have been treated as a distinct family — the Doidae (Donahue and Brown 1987). However, the phylogenetic relationship of *Doa* to other noctuoid families is uncertain, and elevation to family level probably represents only an interim solution. It is likely that the early stages will provide characters useful in illuminating relationships among the doids and other noctuoid clades.

Dyar (1911, 1912) provided superficial descriptions of the early stages of *Doa ampla* (Grote) and *Doa raspa* (Dyar). However, features of the chaetotaxy and crochet arrangement have been presented only recently (Donahue and Brown 1987). The purpose of this paper is to provide

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descriptions and illustrations of the larva, pupa, and adult, and notes on the biology of *Doa dora* Neumoegen and Dyar in Baja California, Mexico. It is not my intention to draw conclusions regarding the phylogenetic position of the Doidae, but to make available specific life history information that has accumulated.

Materials and Methods

A single female *Doa dora* was collected at blacklight (UV) on the north end of Isla de Cedros, Baja California, Mexico, 31 March 1983. A second female was collected the following morning, while it perched on a large bush of *Euphorbia misera* Bentham (Euphorbiaceae). On 2 April 1983, a fourth and a fifth instar larva were collected on *E. misera* by D. K. Faulkner, near El Pueblo, in the southeastern portion of the island.

The adult females were confined together in a plastic bag with a fresh cutting of *E. misera*. They readily oviposited on the leaves and stems of the plant material. I estimated that between 50 and 75 eggs had been deposited by the evening of 5 March. The eggs were taken to San Diego, California, where the larvae were reared to maturity on local *E. misera*. As the eggs hatched, larvae were transferred in small groups to 4.5 ounce glass jars with small pieces of netting for lids. When the larvae reached the third instar, they were transferred to a cylindrical, half-gallon, cardboard container, where they continued to feed and eventually pupated. Rearing was done indoors at ambient temperature (65–77°F).

Upon emergence, most adults were removed. However, the last 5 or 6 were left in the container. Mating took place within 1 to 3 days of eclosion; females readily oviposited on the dry plant material remaining in the container. A second generation was reared from these eggs. Insufficient host material resulted in a brood of dwarfed adults. All specimens are deposited in the collection of the San Diego Natural History Museum (SDNHM).

Description of Early Stages

Morphological terminology and homology of setae follow Stehr (1987); terminology and homology of pupal characters follow Mosher (1916).

Egg. Flattened, oblong, oval; width ca. 0.6 mm, length ca. 0.85 mm; chorion with fine punctations; light yellow when first laid, becoming conspicuously collapsed as embryo develops; becoming transparent 2–3 days prior to hatching, revealing gray larva, with dark gray or blue-gray spot representing head. *Last Instar Larva.* General (Fig. 1): Total length 18.0–22.0 mm. Head small, smooth, shiny, without secondary setae. Thorax inflated, larva appearing slightly humpbacked (although not as pronounced as in *Doa ampla*). Integument with dense

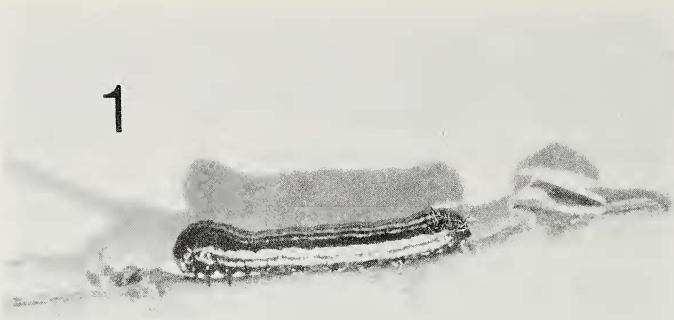

Fig. 1. Last instar of *Doa dora*

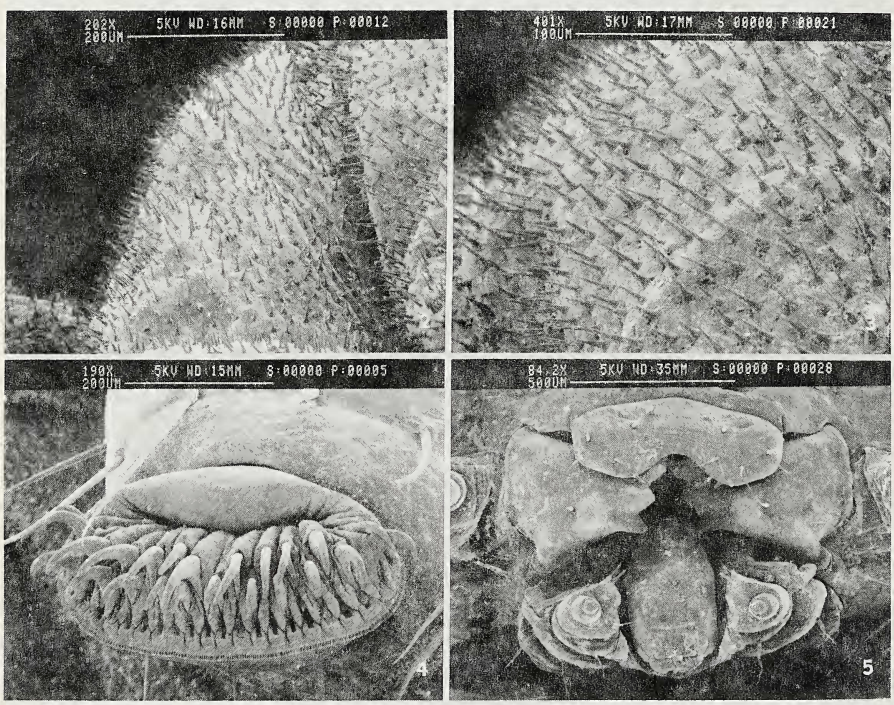

Fig. 2. Integument of last instar larva showing spicules.
Fig. 3. Integumental spicules at higher magnification.
Fig. 4. Crochets of abdominal proleg of segment VI.
Fig. 5. Mouthparts of last instar.

spicules (Figs. 2–3); all setae simple; pinacula small or absent. All prolegs equal in size; crochets biordinal, in homoideous mesoseries (covering approximately 0.60 perimeter of planta) (Fig. 4). Spiracles small, elliptical, peritreme well sclerotized, uniform in size on A1–A7, those on T1 and A8 larger.

Head: As in Figs. 5–7. Width 1.8–2.0 mm. Height of frons approximately 0.8 mm. Length of epicranial suture approximately 0.75 x height of frontoclypeus. Frontoclypeal height slightly greater than its basal width. P1 setae about twice as far apart as P2s, P2s located dorsad of juncture of adfrontal line; A2 dorsoanterad of A1; L1 nearly in a straight line with A1 and A2; L2 posteroventrad of L1. Six stemmata (Fig. 7), 1 and 6 similar in size, larger than 2–5; stemmata 1–4 nearly equally spaced in an arc; 5 and 6 approximately equidistant from 4. Seta S2 below stemma 1; S1 below stemma 6. Labrum with a broad, u-shaped, ventral notch. Mandible (Fig. 10) nearly square, with two lateral setae; inner surface with 3 triangular teeth.

Thorax: As in Fig. 8. Segment T1: Cervical gland absent; prothoracic shield greatly reduced, bearing only XD1 and XD2. D1s closer to meson than XD1s; XD2s slightly further apart than D2s; SD1 dorsad of spiracle; SD2 small, between XD2 and spiracle; L group bisetose, anterad and slightly ventrad of spiracle; SV group bisetose. Segments T2–T3: D2 closer to meson than D1; SD2 directly ventrad of D2; SD1 anteroventrad of SD2; L1 unisetose, in line with spiracles; L2 anteroventrad of L1; L3 dorsoposterad of L1, in nearly straight line with L2 and L1; an extra seta directly posterad of L2 and ventrad of L3; SV group bisetose. Legs: Femur with 2 mesal setae; tibia with 6 setae in ring around circumference; tarsus with 3 setae.

Abdomen: As in Fig. 8. Distance between D2s approximately 2 x distance between D1s. A1–8 with extra seta dorsad of D2, giving appearance of 4 (total) equally spaced D2 setae in transverse line across dorso-meson. SD1 dorsad of spiracle, SD2 greatly reduced. L1 unisetose, posterad of spiracle; L2 and L3 approximately halfway between spiracle and SV1, about one spiracle height apart, L3 slightly ventrad to L2. SV1 unisetose on A1–2 and A7–9, absent on A3–6. SV2 bi- or trisetose on A1–A6 (variable on opposite sides of same segment), unisetose on A7–9. SV3 unisetose on A1–2, absent on A3–9. A9 with D2, SD1, SD2, and L1 on nearly contiguous pinacula in a diagonal line. A10 (Fig. 9) with 20–24 setae irregularly arranged. Prolegs with 12–15 lateral setae; planta with 20–24 biordinal crochets in homoideous mesoseries.

Color: Head shiny brick red; a prominent black patch at stemmata; clypeus and bases of antennae white; labrum black. Body with a series of longitudinal stripes from meson to prolegs arranged as follows: black at middorsum, bordered by white, black, yellow, black, white, black, yellow with two black dots on each abdominal segment (anterior one larger, including spiracle), black, white with two black dots per

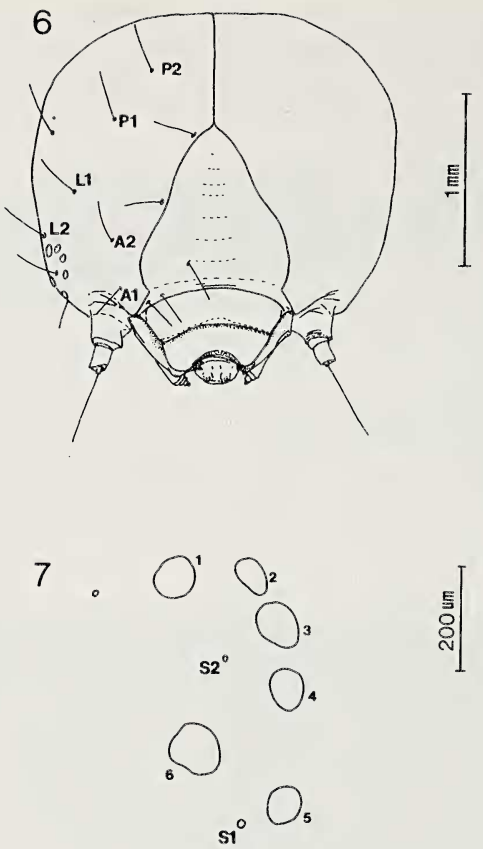

Fig. 6. Head of last instar; anterior view.
Fig. 7. Arrangement of stemmata; lateral view; anterior at right.

abdominal segment, black; A–10 brick red. Thoracic legs brick red; tarsi black. Entire dorsal surface smooth and rather shiny; ventral surface mostly black with diffuse yellow bands laterally between pairs of legs.

Although *D. dora* is most similar to *D. ampla* in both superficial facies and genital morphology, the larvae are remarkably different in coloration.

Pupa: As in Figs. 11–12. Total length 14.5 mm. All appendages closely appressed; setae sparse, similar to last instar. *Head*: Vertex simple, rounded; epicranial suture indistinct. Antennae well defined, filiform, extending nearly to caudal margin of wings. Labrum well defined, square, with rounded corners; mandibles represented by triangular, rounded regions adjacent to, and caudo-laterad of labrum; labial palpus narrow, attenuate, ca 1.2 "x" as long as labrum; maxillae well developed, extending ca 0.33 from eyes to caudal margin of wings.

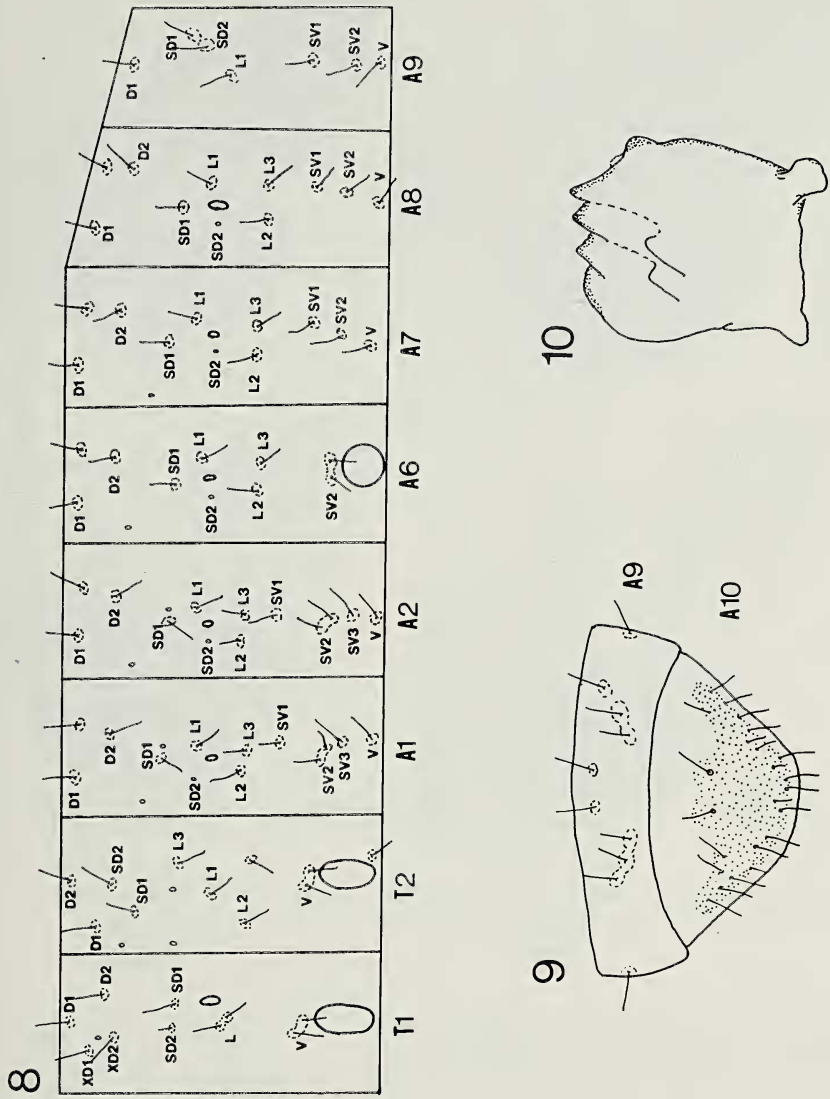

Fig. 8. Setal map of last instar, T1–2, A1–2, A6–9; lateral view, anterior at left.
Fig. 9. Setal map of A9–10; dorsal view.
Fig. 10. Left mandible, mesal view.

Thorax: Prothorax dorsally a narrow collar; ventrally with legs well defined, extending slightly less caudad than antennae. Mesothorax dorsally broad with moderate, mesal, longitudinal, sclerotized hump; ventrally with legs well defined, extending slightly caudad of anten-

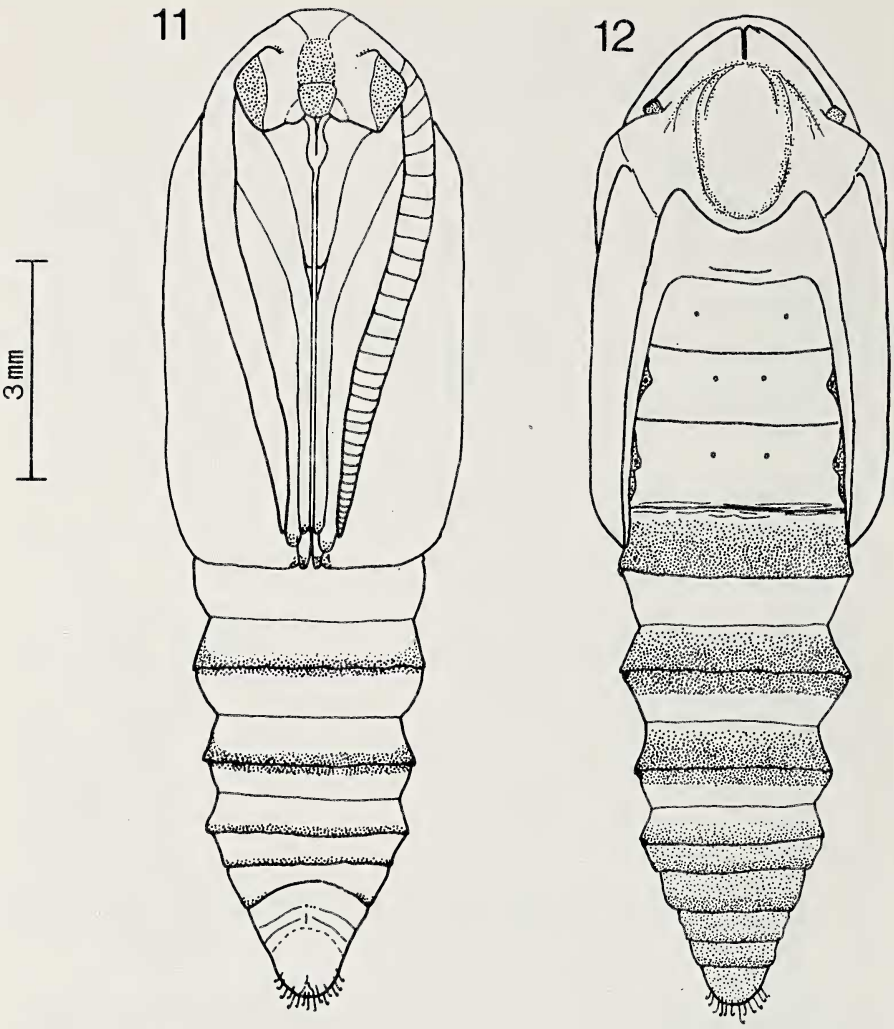

Fig. 11. Pupa of *Doa dora*; ventral view.
Fig. 12. Pupa of *Doa dora*; dorsal view.

nae. Metathorax dorsally a moderate transverse band, with strongly u-shaped margin anteriorly; margin of hindwings conspicuous along entire latero-dorsum. *Abdomen*: Spiracles 1–2 concealed beneath wings; spiracles 3–8 with strongly sclerotized peritreme. Cremaster indistinct with numerous long, distally-hooked bristles. The entire pupa is brown, translucent, and shiny.

The cocoon is an unusual, single layered, wiry, open mesh, nearly twice the volume of the pupa; the cast larval skin and head capsule are included within the cocoon.

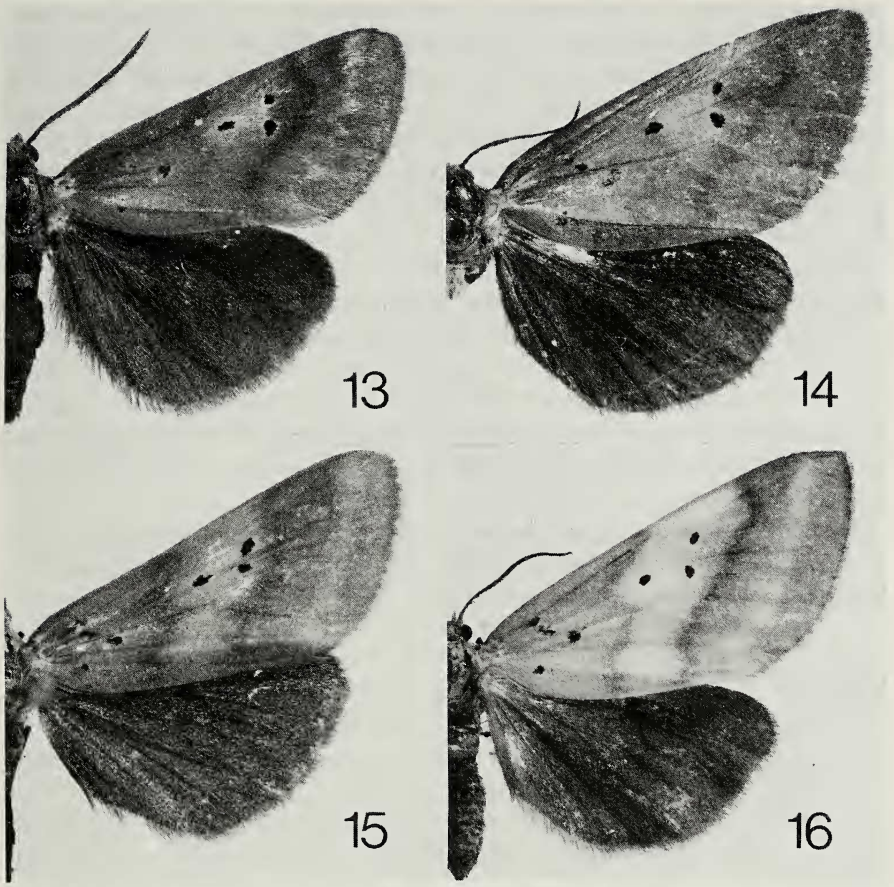

Fig. 13–16. Adults of *Doa dora*: **13)** Male from Baja California; **14)** Female from Baja California; **15)** Male from Colima; **16)** Female from Nayarit.

Biology and Ecology

Doa dora (TL: Guadalajara, Jalisco, Mexico) (Figs. 13–16) is widespread throughout northwestern Mexico, ranging from Baja California to Tamaulipas, and as far south as Colima and Cuernavaca (label data). Although adults have not been taken in the United States, larvae have been collected in San Diego, California (Oceanside, 27-XI-76, on Wandering Jew [Commelinaceae], D. K. Faulkner, SDNHM). Specimens from Baja California and Sonora may represent a closely related, undescribed species. The same is likely for specimens from Tamaulipas. Females from northwestern Mexico are distinguished from typical *D. dora* by a more uniform gray forewing; males possess a large, round, sclerotized region at the base of the valva lacking in *D. dora*. In addition to *D. dora*, the genus includes *D. ampla, D. raspa, D.*

cubana Schaus, *D. translucida* Dognin, and several undescribed species from Mexico and Costa Rica. The relationship of *Leuculodes* to *Doa* has not been examined in a phylogenetic context. The two appear to represent sister taxa, although it is posible that they represent a single genus. The group is in need of systematic revision.

In captivity, eggs of *Doa dora* are laid in irregular, contiguous, parallel rows on the leaves and stems of the host. On Isla de Cedros, the larval host is *Euphorbia misera*. Owing to the limited distribution of *E. misera* (Munz 1974; Wiggins 1980), other euphorbiaceous plants also must serve as larval hosts for *Doa dora*. Early instars live and feed within a loose communal nest, dispersing and feeding externally on the leaf surface in later stages. Early instar larvae will drop by a line of silk when disturbed. In the laboratory, pupation occurred in debris at the base of the host material. Developmental periods were as follows: 10–12 days as ovum; 30–35 days as larva; 15–18 days as pupa.

Females of *D. dora* appear to be partially diurnal, males appear to be more so. The flight is weak and fluttering, similar to *Ctenucha* species. Both sexes are attracted to blacklight (UV).

Discussion

The doids traditionally have been shuffled from family to family by various authors who have based their hypotheses on adult morphological characters. In the most recently proposed classification of the nearctic Lepidoptera, Franclemont (1983) erected the tribe Doaini in the Pericopinae (considered a subfamily of the Arctiidae), to accommodate the genera *Doa* and *Leuculodes*. However, characters of the larvae contradict this placement.

According to Habeck (1987), pericopid and arctiid larvae, respectively, are characterized by the presence of 3 and 4 verrucae above the coxae on T2 and T3, and heteroideous crochets (except for some lithosiines); the head is moderate in size, and integumental spicules are absent. In contrast, doid larvae lack verrucae on the thoracic coxae, have homoideous crochets, the head is very small, and the integument is covered with spicules.

Doid larvae share no uniquely derived characters with lymantriid larvae. Symplesiomorphies include typical noctuoid chaetotaxy and hypognathous head, elliptical spiracles, homoideous crochets, and fully developed abdominal prolegs. Doids lack the abundant secondary setae, which are responsible for the superficial similarity between lymantriids and arctiids, have biordinal as opposed to uniordinal crochets, and lack the fleshy, eversible middorsal gland on A7, which appears to represent an autapomorphy for the Lymantriidae.

Notodontids, likewise, share many noctuoid symplesiomorphies with the doids, but notodontid larvae can be distinguished from doids by

their modified A10 prolegs (sometimes reduced to peg-like structures), and the presence of two MD setae on T3 of the first instar (Hinton 1946), which appears to represent an autapomorphy for the Notodontidae.

The dioptids, which probably represent a specialized group within the Notodontidae, can be distinguished from doids by their larger head (larger than prothorax) and uniordinal crochets. Although the larva of *Phryganidia californica* Packard is similar in general facies to that of *Doa dora*, and possess integumental spicules that are remarkably similar to those of doids, features of the chaetotaxy, crochet arrangement, and mandibular configuration suggest that the two are not closely related.

The unique combination of larval characters possessed by doids appears to contradict traditional assignments of this group to lepidopterous families of similar adult morphology. It is likely that an increased knowledge of the distribution and significance of larval and pupal characters among the various clades of the Noctuoidea may lead to a greater understanding of phylogenetic relationships within this superfamily.

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